

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554**

<b>In the Matter of:</b>	)	
	)	<b>ET Docket No. 03-126</b>
<b>Joint Staff Paper Regarding</b>	)	
<b>Unlicensed Devices and Associated</b>	)	
<b>Regulatory Issues</b>	)	
	)	

To: The Commission

**COMMENTS OF WEBLINK WIRELESS I, L.P.**

WebLink Wireless I, L.P. ("WebLink"), by its attorneys and pursuant to Federal Communications Commission ("FCC" or "Commission") Public Notice, DA 03-1758 dated May 21, 2003, hereby submits its Comments in connection with the Joint Staff Paper Regarding Unlicensed Devices and Associated Regulatory Issues ("Paper") released by the Office of Engineering and Technology ("OET") and the Office of Strategic Planning and Policy Analysis ("OSP") in May 2003. The Comments are due by August 21, 2003. In support of WebLink's Comments, the following is respectfully shown.

**I. STATEMENT OF INTEREST**

WebLink is a Commercial Mobile Radio Service ("CMRS") provider located in Dallas, Texas. It provides nationwide messaging service. It is a leader in the wireless data industry, providing wireless email, wireless messaging, information on demand and traditional paging services throughout the United States. WebLink's FCC licensed subsidiaries hold 929 MHz exclusive paging and Narrowband Personal Communications Service ("NPCS") licenses. Because the recommendations in the Paper could significantly impact WebLink's use of its spectrum, WebLink is an interested party in this proceeding.

## **II. INTRODUCTION**

In the Paper, the authors present a primer on unlicensed wireless devices with the theme that these devices are experiencing unprecedented growth into a multi-billion dollar industry. According to the Paper, without spectrum policy reform addressing the problems of interference and maintaining low entry barriers to spectrum, the benefits of unlicensed devices may be delayed or unrealized. The Paper identifies some of the potential regulatory issues that unlicensed devices face and assesses some Spectrum Policy Task Force's ("Task Force's")<sup>1</sup> recommendations for unlicensed spectrum, stating that the future success of unlicensed operation will depend on how the FCC manages future migration. The Paper concludes that effective policy reform includes providing more unlicensed spectrum and promulgating rules to encourage technological and market-based solutions for more efficient use in sharing of the spectrum, which includes allowing unlicensed devices to operate as an underlay in bands that are currently allocated to existing licensed services. The Paper accurately states that these issues are complex and that industry must be involved in their resolution.<sup>2</sup>

While WebLink commends OET and OSP for their review of the regulatory issues with respect to unlicensed devices, it has concerns that the Paper has accepted the Task Force tenets without adequate analysis.

## **III. DISCUSSION**

### **A. The Paper Raises Issues of Concern.**

Building on the Task Force's hypotheses, the Paper states that a potential solution to increased unlicensed operations is to allow unlicensed devices to operate as an underlay in bands

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<sup>1</sup> Spectrum Policy Task Force Report, ET Docket No. 02-135, released November 15, 2002.

<sup>2</sup> Paper at 50.

that are currently allocated to existing licensed services.<sup>3</sup> WebLink opposes any proposals relating to shared access in the form of underlays or easements in exclusive spectrum, specifically with respect to paging and messaging frequencies, on the basis that such use is likely to cause interference to its networks.<sup>4</sup>

## **1. Interference.**

As the Paper acknowledges, “At the heart of all spectrum concerns lies the question of interference.”<sup>5</sup> The Paper agrees with the Task Force that a review of the limits on harmful interference would prove helpful with unlicensed devices. Expanding on that concept, the Paper states that interference that may be intolerable in one service might be acceptable to another because interference imposes a cost on the user, i.e., if the device is low-cost and operation is free, the burden of interference would not be a problem. However, the obverse is not true: if an unlicensed device is operating in an underlay to a licensed frequency that is supporting paying customers, any interference to those customers from an unlicensed device would be intolerable and would have consequences to the licensee.

The Paper states that a better definition of what constitutes interference may be necessary because radio ranges have become smaller and therefore more devices can be used in an area without ill-effect. It does warn however, that in refining this definition, spectrum users in densely populated areas may be expected to tolerate some congestion. Eventually, the Paper states, “We would like to maximize spectrum use efficiency and accommodate competing uses.”<sup>6</sup> Accommodating competing uses is not appropriate for paging and messaging spectrum. As

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<sup>3</sup> Paper at 45.

<sup>4</sup> Task Force Comments of WebLink, Exhibit I at 4.

<sup>5</sup> Paper at 45.

<sup>6</sup> Paper at 46.

pointed out in WebLink's Comments on the Task Force's Report, because of their narrow channels and restricted bandwidth, paging and messaging networks are very susceptible to interference, but do not have a great deal of capacity to recognize it.<sup>7</sup> As a result, the exclusive paging and messaging bands cannot be subject to any sharing.

In the Task Force proceeding, WebLink questioned the basic assumption that the Task Force Report made concerning spectrum, an assumption that is also implied in the Paper. The Task Force used a model that assumes that the spectrum "box" is only partially filled; that a partially filled box is a poor model of resource allocation; and that it would be desirable to fill the box.<sup>8</sup> This assumption is inaccurate with respect to paging and messaging carriers. The emphasis should be on the end-to-end flow of application-oriented information and the ongoing degradation events that are encountered. However, the Task Force's "proxy" for channel efficiency does not address the impact of degradation upon the whole process of end-to-end wireless messaging communications. It also assumes a voice-implicit model for interference protection. This is not applicable to paging and messaging carriers in their provision of wireless data messaging. The measures of channel efficiency and message latency in paging and messaging service would be much more compromised than a wireless phone service.<sup>9</sup> If sufficient degradation is encountered, the intended messaging recipient may never receive the message and would not know that it had been sent. Further, wireless data communications is "bursty" and channel degradation is likewise "bursty."<sup>10</sup> Because of this, the "spectrum box" is not uniformly filled. In addition, channel coding and retransmission must work around this

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<sup>7</sup> Task Force Comments of WebLink at 4.

<sup>8</sup> Task Force Comments of WebLink, Exhibit 1 at 1.

<sup>9</sup> Task Force Comments of WebLink, Exhibit 1 at 2-3.

<sup>10</sup> Task Force Comments of WebLink, Exhibit 1 at 3.

information in the box, which further reduces the volume in it. In sum, there is not enough room in the paging and messaging box for underlying unlicensed users.

## **2. Receiver Solutions.**

The Paper notes that “there is little incentive for licensees to require that their receivers be any more sophisticated...”<sup>11</sup> This is directly contradicted by CMRS commenters in the FCC’s *Notice of Inquiry* in ET Docket No. 03-65 (“*NOI*”),<sup>12</sup> who stated that the incentives of competitive markets and industry cooperation have been successful in improving interference immunity in CMRS wireless communications technologies.<sup>13</sup> These commenters were adamant that restricting the industry with an inflexible regulatory structure for receiver standards would stifle the industry; that any mandatory FCC standards could squelch innovation and isolate the U.S. industry from the global wireless marketplace;<sup>14</sup> and that receiver standards could open the way to underlays or easements in exclusive licensing, which would produce chaos in the existing exclusive license scheme.<sup>15</sup> Further, with respect to paging and messaging equipment, IEEE correctly notes that narrowband wireless receivers already typically have higher interference immunity than wideband receivers.<sup>16</sup>

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<sup>11</sup> Paper at 46.

<sup>12</sup> *Interference Immunity Performance Specifications for Radio Receivers, Notice of Inquiry*, FCC 03-54 (released March 24, 2003) (the “*Notice*” or “*NOI*”). The *NOI* was published in the Federal Register on May 5, 2003, which established a comment deadline of July 21, 2003. See 68 Fed. Reg. 23677.

<sup>13</sup> *NOI* Comments of Cellular Telecommunications & Internet Association (“CTIA”) at 2.

<sup>14</sup> *NOI* Comments of AT&T Wireless Services, Inc. (“AT&T”) at 13.

<sup>15</sup> *NOI* Comments of BellSouth Corporation and Cingular Wireless LLC (“BellSouth/Cingular”) at 12-13, citing the FCC Technological Advisory Council II, Sixth Meeting Report at 14 (Sept. 18, 2002)

<sup>16</sup> *NOI* Comments of IEEE at 4, ¶ 6.

Nevertheless, the Paper comments that the hidden cost in the non-regulated receiver environment is that “few, if any, others can make simultaneous use of this valuable commodity known as spectrum.”<sup>17</sup> According to the Task Force, and this Paper, this simultaneous use would require the development of an “interference temperature,” which would permit spectrum management “by establishing a threshold on the noise environment in which receivers would be required to operate,” thus allowing more devices to share a given band.<sup>18</sup>

The problem in the measurement of RF noise floors is that the measurement would not be constant.<sup>19</sup> In fact, it is questionable whether this concept of interference temperature should be applied to communications networks at all since this theory comes from thermodynamics and pertains only to systems that have reached a form of steady-state in which energy is equally distributed.<sup>20</sup> In contrast, most communications networks do not operate under steady-state conditions, but are subject to rather extreme fluctuations in volume. Consequently, “[i]f ‘interference temperature’ is deemed to measure only the average background level, then it will certainly fail to capture the property of extreme fluctuations in level.”<sup>21</sup>

In addition, “the proposed proxy for spectrum efficiency completely misses the essential fact that the increase of ‘interference temperature’ will have significantly different impacts on service efficiency subject to channel constraints in many services.”<sup>22</sup> Noise floor is a critical

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<sup>17</sup> Paper at 47.

<sup>18</sup> *Id.*

<sup>19</sup> Task Force Comments of WebLink, Exhibit 1 at 5-6.

<sup>20</sup> Task Force Comments of WebLink, Exhibit 1 at 4.

<sup>21</sup> *Id.*

<sup>22</sup> Task Force Comments of WebLink, Exhibit 1 at 5-6.

factor. Operations in a given service are premised on the existing noise floor. Systems have been designed to provide reliable service over a given area and with a particular quality of service based on the expected noise floor. For example, an increase by even a few dBs could impact WebLink's existing licensed system and its customers, with respect to coverage, system capacity and reliability of data throughput.<sup>23</sup>

In any event, WebLink believes that the actual distribution of interference makes the physical layer design of the receivers unimportant. *See* Exhibit 1 attached hereto. Instead, interference has to be managed at higher layers of the protocols (i.e., software) between receivers and transmitters.

### **3. Smart Radio Devices.**

Fortunately, the Paper appears to be more realistic in its approach to smart radio devices than the Task Force. The Paper reports that there are some drawbacks to smart radio devices in that they would add costs to inexpensive unlicensed devices. Further, a smart radio may have to reduce its power so much or change frequencies so often in an effort to find and use “whitespace,” that it could not be detected by a smart receiver.<sup>24</sup>

It should also be noted that frequency agile radios or smart radios are not available in the paging and messaging industry and there would be a substantial delay in the production of such equipment. Even if smart radio devices were available, paging and messaging carriers operate low cost service. New frequency agile equipment would raise the cost of operations and ultimately, could force customers to abandon the service. Since the paging and messaging customer base has eroded over the past several years, such a regulatory requirement could add to

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<sup>23</sup> Task Force Comments of WebLink, Exhibit 1 at 5.

<sup>24</sup> Paper at 47.

the outflow of the paging and messaging consumers and further threaten the financial viability of the paging and messaging industry.<sup>25</sup> In the future, smart radio devices may offer valuable opportunities; however, they are not presently available to be assimilated into a viable spectrum policy, particularly for paging and messaging spectrum.

#### **4. Spectrum Solution.**

The Paper reports that in the Spectrum Policy Task Force proceeding, there was great support for additional spectrum for unlicensed operations.<sup>26</sup> WebLink also supported it.<sup>27</sup> The present FCC frequency allocations also provide a basis for additional spectrum for unlicensed devices: one *NOI* commenter stated that only seven percent of spectrum allocations lie in the entire spectrum above 3 GHz, which means that 93% of the allocations are between 0 to 3 GHz.<sup>28</sup> It thus seems unnecessary to squeeze additional users into already occupied spectrum.

Since any other changes such as underlaying would affect the fundamental right of incumbents, the Commission should allocate separate bands for unlicensed services on a going forward basis in bands above 50 GHz. As the Task Force Report states, in these bands:

The propagation characteristics of spectrum preclude many of the applications that are possible in lower bands...and instead favor short-distance line-of-sight operation using narrow transmission beams. Thus, these bands are well-suited to accommodate multiple devices operating within a small area without interference.<sup>29</sup>

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<sup>25</sup> *Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, Eighth Report*, FCC 03-150, ¶ 141 (released July 14 (2003) (“*Eighth CMRS Competition Report*”))

<sup>26</sup> Paper at 48.

<sup>27</sup> Task Force Comments of WebLink at 9.

<sup>28</sup> *NOI* Comments of BellSouth/Cingular at 11-13.

<sup>29</sup> Report at 39. Emphasis added.

**B. Unlicensed Operations Should Not Be Permitted as Underlays or Easements in Exclusively Licensed CMRS Spectrum**

WebLink has obtained six NPCS auction licenses for which it paid over \$130,000,000.00. Additionally, it has built a multimillion dollar paging and wireless messaging network; and it pays monthly site leases for its approximately 2000 sites throughout the nation. It bid on the NPCS licenses based on the technical and service rules in place and expected to have a stable operating environment going forward. Those expectations were the basis for the system design and engineering for the deployment of an efficient system. It is an economic necessity that WebLink be assured that it will be protected from significant and costly changes to its network caused by regulatory fiat.

WebLink must also be assured that it will be provided protection from interference. As discussed above, interference is a real, almost constant issue for the paging and messaging industry, even without frequency sharing on its licensed frequencies. WebLink cannot be assured of interference protection under the interference temperature scenario: "...the real problems arise when interferers yield non-linear effects such as inter-modulation distortion, receiver self-quieting, phase steps or FM click noise." <sup>30</sup>

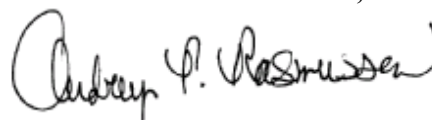
The existing interference management methodology for paging and messaging frequencies has been tested and refined through a long process. WebLink believes that this methodology is adequately providing interference protection to operators and should be kept intact. Any change in methodology to accommodate unlicensed users would raise the noise floor level and require a paging and messaging carrier to change its system or mitigate interference caused by such users in its frequency band. RF monitoring equipment would have to be installed at the licensee's sites. However, it is almost impossible to locate interfering unlicensed devices

because they have no IDs and are not confined to a fixed location. Consequently, it may not be possible for the incumbent to mitigate interference without incurring the cost of reengineering. Allowing unlicensed users in the paging and messaging frequency bands could also limit technical and service options and definitely would limit flexibility. Any change in the approach to interference protection would drastically change the terms of the WebLink licenses. Accordingly, WebLink requests that the Commission consider the adverse consequences to the paging and messaging industry from any regulatory change to these frequency bands. It should not allow existing exclusive licensees to have their signals degraded by unlicensed spectrum users at the expense of the public.<sup>31</sup>

### **CONCLUSION**

**WHEREFORE**, the foregoing having been duly considered, WebLink Wireless I, L.P. respectfully requests that the Commission will not subject the paging and messaging industry to unnecessary receiver regulation or allow underlaying in its spectrum.

Respectfully submitted,  
**WEBLINK WIRELESS I, L.P.**



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**ITS ATTORNEYS**

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<sup>30</sup> Task Force Comments of WebLink, Exhibit 1 at 4.

<sup>31</sup> The only palatable approach offered by the Paper would be that the Licensee be allowed to charge unlicensed operators an access fee for use of its authorized spectrum. This would allow the Licensee to know the source of any interference. Such an approach, however, must be strictly voluntary, without any regulatory consequences if the Licensee did not want other users on its spectrum.

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Dated: August 21, 2003

## Exhibit 1



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### MEMORANDUM

From: Allan Angus, PE, MSc  
Date: 08/21/03  
Joint Staff Paper Regarding  
Re: Unlicensed Devises and  
Associated Regulatory Issues

### 1. Receiver Design

Our primary argument is that the observed range of interference is too extreme for a simple "physical layer" improvement of receivers to manage. Instead, interference has to be managed at higher layers of the protocols (i.e., software) between receivers and transmitters; and how this is to be done needs also to be adapted to the nature of the traffic, for example, treatment for digital voice will be different than for messaging. Hence, there can be no common approach that the FCC could mandate for all services, and mixing services in any spectrum would also be problematic; e.g., digital voice as an overlay or underlay with messaging. Further, the industry will always be motivated to improve these aspects of communication because improving protocols (software) will always be less expensive than modifying hardware.

Most digital modulations will work reasonably well with a ratio between the signal energy and noise energy of about 10 to 20 dB or a factor of somewhere between 10:1 and 100:1. Most digital radio systems are designed to operate well at a threshold in this range.

Received energy is reduced as the distance between the transmitter and receiver is increased. In the radio bands of interest to us, this relationship is about inversely proportional to distance to the 4<sup>th</sup> power; i.e., Power received =  $k/d^4$ , where k depends on antenna heights, gains, power transmitted, etc.

One would like the coverage distance (or area) to be as large as possible usually, so one would be able to get the receiver to work with the least possible energy. In practice, that means trying to keep the total noise and interference that the signal energy has to work against to be as small as possible.

There is always a fundamental limit in this kind of work; and in this case, it has to do with random motions of electrons in the component parts of the receiver. These random motions create electrical noise that can only be reduced in principle by cooling the components down to absolute zero, which doesn't work well for pagers or cellphones right now. So, one is stuck with this rock-bottom thermal noise (Johnson-Nyquist noise, for the record.) While thermal noise is

random, it's quite predictable in terms of its average energy. One way to think about receiver design is how much energy is necessary to contrast against this built-in thermal noise. The answer is usually between about 10:1 and 100:1.

The problem here is external man-made interference. This comes from all kinds of sources, a cacophony of intentional and unintentional radiators. The graphs below show our measurements of this interference energy as it arrives at our network receivers at thousands of base stations around the country over several months.

This data shows that the measured range of interference energy (or power) expressed as a ratio of the rock-bottom internal thermal noise goes anywhere from 0dB to around 60db. That is to say that measured external interference power can be anywhere from equal to or less than the self-noise of the receiver up to 1,000,000 times plus, greater than the self-noise of the receiver. There is also no "national average" interference power, which means that if you look at the graph there is no "bump in the middle."

In fact, this curve is very similar to the statistics for the strength of earthquakes.<sup>1</sup> There are millions of little "rumblers" every month around the world, but only every once in a while does a magnitude "5 on the Richter scale" come along. Unfortunately for radio receivers in the UHF band, sites that are at "magnitude 6 on the interference-earthquake scale" are a common occurrence.

So, by analogy, these interference earthquakes are constantly "taking down the bridges" between transmitter and receiver in our service. The Commission proposes, in essence, to build the bridges stronger. The counter-proposal, since these bridges are "ephemeral," is to let the interference take the bridges down; and simply re-build them rapidly. In essence, that is what is meant by "higher layer protocols"... rebuilding the bridges by software.

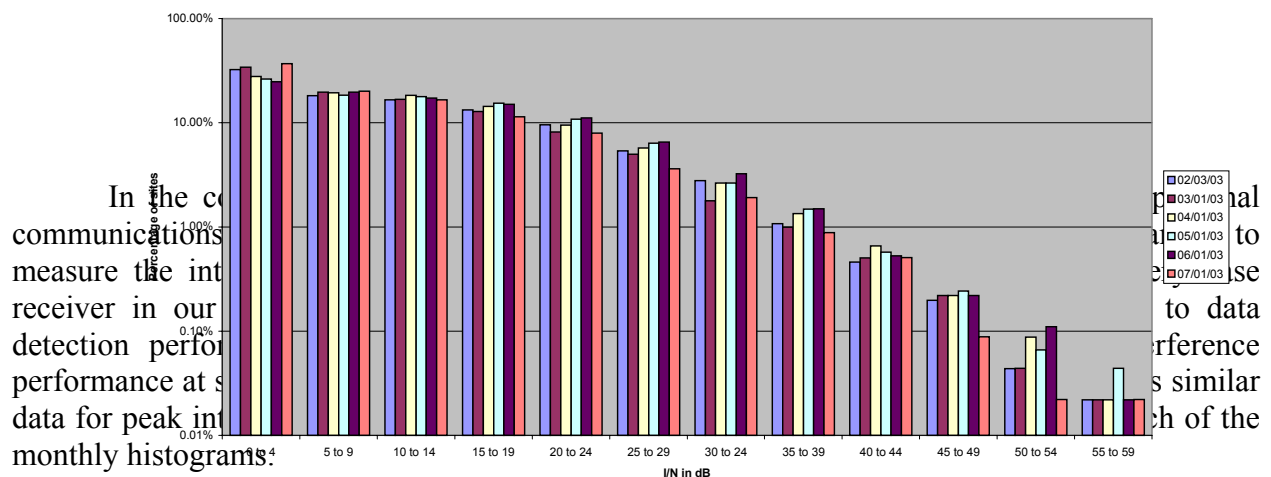
It's also worth noting that these "interference earth-quakes" are highly intermittent. So just because a site shows an average interference value of say, 20 dB (or magnitude 2) doesn't mean that there are no occurrences of 60 dB bursts of interference (or short tremors of magnitude 6 on the interference Richter scale).<sup>2</sup> The data are smoothed across a month, and the short tremors simply get averaged out.

If the graphs did show something that looked more like a bell-curve, with a clear average interference nationwide, then what the FCC appears to be attempting to do might work. One could then say, "Here's the expected value of interference, let's get our signal levels about 10 to 100 times greater." Or to go back to bridge building, here's the average earthquake around here, let's build our bridge 10 to 100 times stronger. Our advantage as communications engineers in this regard is that we can let nature destroy our "bridges" because we have the means to repair them rapidly with little if any loss in the data that we are transporting.

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<sup>1</sup> See P. Bak, Ch. Tang, and K. Wiesenfeld, *Phys.Rev.Lett.* 59 (1987) 381.

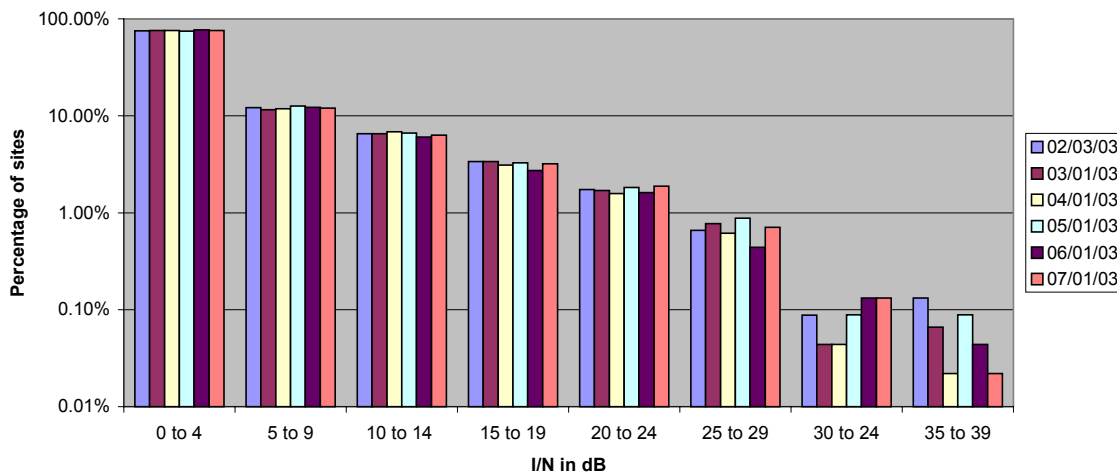
<sup>2</sup> There is a broad body of references in the technical literature in this earthquake analogy, beginning in 1951 with H.E. Hurst, "Long-term storage capacity of reservoirs," *Trans. of the Amer. Soc. of Civil Engineers*, 116, pp770-808, 1951. Hurst was the engineer charged with the design of the Aswan High Dam on the Nile River. Also worth noting would be B.B. Mandelbrot, "Self similar error clusters in communications systems and the concept of conditional stationarity," *IEEE Trans. on Comm.*, 13, pp.71-90, 1965. In any case, the analogy is a strong one.



A few points are worth noting. The data show the relative amount of interference power above the self-noise threshold in each receiver on a dB scale. The percentage of receivers falling into 5dB ranges is given in each of the histograms. The histograms for average interference to noise (“I/N”) ratio are roughly linear on the logarithmic scales used; there is no mean or expected measure of central tendency, no peak in the middle. This implies that the underlying probability distribution varies inversely as some power of I/N. The specific receivers that constitute the poorer performers in any given monthly sweep differ from month to month.

Another point to note is that the distribution of peak I/N ratio is much more disperse than

**Exhibit 1. Average Interference to Noise**



that for the average I/N; 75% of receivers are in the lowest range (or bin) on the average distribution, while only about 30% fall into that category on the peak distribution. This suggests that interference is significantly “impulsive.” Furthermore, receivers that are outliers on the peak distribution may be perfectly acceptable on the average distribution.

While we are referencing this discussion to “receivers,” this is not perfectly accurate. These measures reference an independent and external, man-made interference power to a theoretical and practical noise floor at the receiver that is strictly a function of received signal bandwidth and temperature. This noise floor defines the ‘0 dB’ value only. For the receivers in question, the noise figure is so close to 0 dB that it is not worth considering in the face of the huge range of interference values.

Every month’s sweep reveals about the same fraction of receivers that fall above any arbitrary measure. Each curve is roughly the same, even though the particular receivers change. While this data set pertains to land stations, we expect that similar data pertain to the mobile receivers.

Any practical measure of data transmission quality (bit error rate, message error rate, frame error rate) will be a strong function of signal to noise or interference ratio. Furthermore, received signal strength falls off as roughly the fourth power of path length in the UHF bands of interest to us. So, the charts above demonstrate that the practical coverage areas served by any given site are in fact as impulsive and time dynamic as the peak I/N distribution shows.

The interference immunity of receivers will not be achieved by “brute force” methods that aim to account for the nearly 60 dB of observed range in I/N ratio by designing it out. Rather, such extreme variations in instantaneous carrier to noise or interference ratio (“C/N” or “C/I”) can only be managed by the proper design of protocols that (i) “whiten” the interference to the extent possible by the application of channel diversity mechanisms; and (ii) implement data retransmission (“automatic repeat request” or “ARQ”) mechanisms for those data segments that are unavoidably lost and are needed.

The Commission should note that the operating NPCS networks already embody channel diversity mechanisms (through simulcast on the forward channel and multi-branch diversity on the reverse channel) and ARQ mechanisms. We have long ago realized that the investment of significant resource in improving the inherent interference immunity of the fixed and mobile receivers in our networks is roughly akin to King Canute’s command that the tide not rise to his throne. The tide will rise today, and next month we will discover that roughly 2-3% of our receivers have peak I/N ratio of 30 dB or more. We will avoid the otherwise pernicious impact of this by employing sophisticated channel diversity mechanisms and data retransmission protocols.